Composite structural design in the presence of stress constraints

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For a composite with microstructure of characteristic length scale ε, the stress distribution function $\lambda^\varepsilon(t)$ is defined to be the volume of the composite that experiences equivalent stress above the value t. Here the equivalent stress can be of Von Mises type or more generally can be any nonnegative quadratic function of the stress. New homogenization results are presented that provide bounds on the stress distribution function inside composite materials in the limit of vanishing ε, see [2]. For points away from the structural boundary these results provide point wise bounds on the equivalent stress that apply for sufficiently small ε.

The homogenization results are used to develop numerical algorithms for the design of composite structures in the presence of point wise and integral constraints of L^p type on the equivalent stress. Numerical examples are given for composite bars in torsion [3], [4].

We apply the theory to problems of topology design and provide an alternate interpretation for some of the insights presented in [1].

References

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